



Charlotte Mason's House of Education,
Scale How, Ambleside, UK, 2009

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OBJECT LESSONS IN THE NURSERY.

BY ETHEL R. LUSH,

Head Mistress of the Ipswich Higher Grade Girls' School; Organizing Mistress to the Ipswich School Board.

II. SOAP AND WATER.

[APPARATUS required: Bowls of cold, hot, hard and soft water respectively; a dirty duster, soap, chalk, glass of boiled hard water, washing soda, caustic potash, oil and empty oil bottle, test tubes.]

Soap and water! You think you know a great deal about these two things already. Let us see if there is anything more to be learnt about them. You know what a magical effect a little soap and water has on dirty hands and face; have you ever wondered *why*?

Here we have a bowl of clean cold water and a dirty duster, which I shall try to wash. After rubbing diligently for a few minutes we may observe two things—the duster is cleaner and the water dirtier. From this we learn that *water has the power of dissolving dirt*. If you have noticed after a heavy shower of rain first the beautifully clean pavements and then the muddy water in the gutters, you have learnt this fact in another way.

But our duster is not yet clean, so this time I will try what warm water will do. It is easily seen that the dirt leaves the duster much more rapidly than in the first instance. This teaches us that *hot water is a better solvent than cold water*. To prove this in a very simple way, drop one lump of sugar into a glass of cold water and another lump of the same size into a glass of hot water, and notice how long each lump will take to dissolve.

Look now for a little while at two other bowls of water, one containing hard, the other soft water. I will continue to wash the duster, which is still far from clean, using first the bowl of hard water and a little soap. Observe with what difficulty a lather is obtained, and how very slowly the dirt dissolves into the water. Now I remove the wet cloth to the bowl of soft water and go on with the cleansing process. A change takes place immediately; a good lather is quickly formed, the water rapidly assumes a darker hue, and at last the duster is clean.

It is plain, from what you have just seen, that *soft water dissolves dirt more readily than hard water*. Let us see wherein the difference lies.

Rain-water is always soft. In towns where the water supplied is hard the inhabitants collect the falling rain in butts and tanks, and use it for cleansing purposes. Most of the rain, however, sinks into the ground, and disappears from sight to reappear, at some future time and place, in the form of a spring or stream. It is interesting to know how springs are formed.

The earth's crust is made up of layers or strata, differing from each other in composition; thus we may have, for instance, an outermost stratum of gravel, underneath this a layer of chalk, and under this again a bed of clay. Rain falling upon ground of this character would pass first through the gravel, next through the chalk, and finally reach the clay. Gravel and chalk are porous, but clay is non-porous, consequently instead of passing through this stratum too, the water would run along its surface, forming an underground stream, which would eventually find an outlet, possibly in the side of a hill or cliff. During its slow downward journey through the earth the water dissolves some of the mineral substances through which it passes, the commonest being chalk or carbonate of lime, and in this way the soft rain is turned into hard water.

We have here a glass of soft water into which you may crumble a small piece of chalk; observe how very readily water dissolves the solid chalk. The change thus wrought in the water has an important effect upon it for all domestic purposes.

You have seen with what difficulty a lather is obtained in hard water, but to recall to your minds the difference between soft and hard water with respect to soap, we will take two small bottles, half fill one with soft water and the other with hard, add a little soap to each and shake them well. The soft water quickly forms a good lather, whereas the hard water is covered with scum and curdled soap, and if we wish to obtain a lather we must add more soap.

From this simple experiment we learn that *hard water is less economical than soft water*, inasmuch as a certain amount of soap is always used up in neutralising the hardness, or, in other words, removing the grains of chalk, before a lather can be obtained.

You have heard how soft water may become hard, now let us see whether hard water may be softened. You remember that *hardness of water is owing to the presence in it of certain dissolved minerals*, of which carbonate of lime is the chief. There is in water a gas, which holds the chalk prisoner, as it were. Luckily this gas may be driven off by boiling the water, and when this is done the chalk is set free and falls to the bottom of the vessel. Look inside the tea-kettle, and you will probably find a greyish-white brittle substance, which is no other than the liberated carbonate of lime.

We take next two glasses, the one filled with clear, cold, sparkling water, the other with hot, dull and milky water. Need you be told that the first glass contains water as drawn from the tap, the second boiled water? The flat taste and dull appearance of the latter is due to the fact that the gas, of which I told you, has been driven away, and as the result you may see tiny particles of chalk in the bottom of the glass. If you add a little soap to this boiled water you will find it comparatively easy to get a good lather.

There are many other ways of softening water, but boiling is the simplest of all.

Before we can talk about *soap*, I wish you to examine carefully this piece of washing soda. Taste a tiny bit, and notice how peculiarly biting and bitter it is. If instead of soda you were to taste lime or potash, you would notice the same bitterness. Substances of this kind are called *alkalies*. They are exactly the opposite to *acids*, such as vinegar and lemon-juice, which, as you know, have a sharp, sour taste. Acids may be obtained from the vegetable world, as in the case of lemon-juice; from the animal world, as, for instance, the acids in the fat of meat; or from the mineral world, as sulphuric acid. Now that you understand the meaning of the words alkali and acid, we may go on with our experiments.

Here is an empty bottle, which has once contained oil and still has very greasy sides. I fill it with warm water, shake it well, but all to no purpose—the oil clings obstinately to the sides of the bottle, and refuses to mix with the water. Let us try another plan. Add to the water in the bottle a small piece of washing soda and shake the bottle again. This time we find that oil, dirt, soda and water have all mixed together, and the sides of the bottle are clear. It is plain from this that *soda has a solvent action on oil or grease*.

Watch again. Here is a test-tube half filled with oil, and, having dissolved several pieces of soda in water, so as to make a strong solution, I add this to the oil and shake the test-tube well for some time. Now you may observe a change taking place in the tube—the soda is splitting up the oil into two parts, uniting with one to form a new substance, which you may see on the top of the mixture, and setting free a watery substance, which remains at the bottom of the tube. Examine the new substance for yourselves. You have no hesitation in pronouncing it to be soap, although it is quite soft. If we wish it to harden, we must boil it and thus drive off the excess of water. It is much in this way that all soap is made. Waste fats, such as tallow, dripping, linseed oil, fish oils, etc., are collected by the soap makers, melted down and boiled, and gradually mixed with a strong solution of soda called the “lye.” Boiling is continued, and the soda unites with the acids of the fats to form soap. The watery substance left behind is known as glycerine. You may easily make a piece of soap for yourselves by boiling part of a tallow candle in water with soda; add a little salt, let the mixture cool, and at the top of the vessel you will find a cake of soap. Squeeze it to get rid of some of the water, and the result will satisfy you.

From these experiments we learn that *soap is made by the union of an acid with an alkali*; the acids are always fatty acids, but the alkali used may be either soda or caustic potash.

A few words will suffice to explain why soap and water so readily remove the dirt from our skins. If you use water alone you will remove *some* dirt, because, as we have seen, water is a solvent; but drops of water stand isolated on the surface of the skin until we take a piece of soap, and then the dirt is quickly removed in a mixture of soap and water. Later on you will learn something of the structure of the skin, but to-day we must be content to notice its greasy nature. If it were not thus supplied with oil the skin would dry and crack. It is owing to this oil that soap is so necessary. The dirt which gathers on the skin becomes mixed with oil and perspiration, and thus water alone is not sufficient to remove it. Soap is used, the alkali in it unites with the oily mixture, the whole is washed away by water, and you are clean once more.